DOCUMENT RESUME

ED 318 563 PS 018 746

AUTHOR Kambiss, Patricia A.
TITLE The Effects of Cooperative Learning on Student Achievement in a Fourth Grade Classroom.
PUB DATE 90
NOTE 90p.; Research Project Report, Mercer University.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Academic Achievement; *Cooperative Learning; Grade 4; *Grouping (Instructional Purposes); Intermediate Grades; Pretests Posttests; *Spelling Instruction; *Student Improvement

ABSTRACT

The purpose of this study was to examine the effects of cooperative learning on spelling achievement in fourth grade. During the 12-week treatment period, students (n=25) in the experimental group were heterogeneously grouped and received instruction by means of cooperative learning techniques. The control group (n=26), which was not grouped in any specific manner, received an equal amount of instruction in spelling using traditional techniques. Both groups received the same assignments and covered the same content. Pretests and posttests were administered. There was a significant difference between the spelling achievement of the two groups of students in favor of the students who worked together cooperatively. (PCB)

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# THE EFFECTS OF COOPERATIVE LEARNING ON STUDENT ACHIEVEMENT IN A FOURTH GRADE CLASSROOM

by

Patricia A. Kambiss

A RESEARCH PROJECT REPORT

Presented in fulfillment of the Requirements for the
Educational Specialist Field Problem in the
Graduate Program of Education at
Mercer University in Atlanta

Atlanta, Georgia

1990

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ABSTRACT

THE EFFECTS OF COOPERATIVE LEARNING ON
STUDENT ACHIEVEMENT IN A FOURTH
GRADE CLASSROOM

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Purpose

The purpose of this study was to examine the effects of cooperative learning on spelling achievement in a fourth grade classroom. During the 12 week treatment period, students in the Experimental Group were heterogeneously grouped. The Control Group was not grouped in any specific manner. Both groups received the same amount of spelling instruction, although the Experimental Group was responsible for its own method of instruction. This study was designed to answer the following question: Is there a significant difference in the spelling achievement of fourth grade students who are taught through cooperative learning

groups and those who are taught in the traditional manner?

## Methods and Procedures

Before the study began, 25 students from an intact classroom were assigned to groups based on Reading level. The 26 students from the Control Group were not grouped in any manner. The members of the Experimental Group received treatment in cooperative learning methods over a 12 week period. Both groups (51 students) were given a pretest on August 28, 1989. A posttest was given on November 17, 1989. Both groups received the same teacher-made pretest and posttest.

During the treatment period, the Experimental Group worked with cooperative learning techniques 80% of the allotted time for spelling instruction within a given week. Positive interdependence, face-to-face interaction, individual accountability, collaborative skills, and processing (Johnson, Johnson, & Holubec, 1986) were closely monitored.

## Results

The mean gain scores of the group were analyzed by a t-test at the .05 level of significance. The

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results indicate that there was a significant difference favoring students who worked together cooperatively.

## Conclusions

The results of the present study indicate that cooperative learning does enhance an individual's learning. Based on these results, teachers may want to do additional research in areas other than spelling. Content areas such as Math, Social Studies, or Science may be incorporated using cooperative learning methods. More research could be done in the area of teacher training. Teachers with no training could be compared with teachers who had attended in-services and/or workshops on cooperative learning methods.

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Section I

# INTRODUCTION AND PROBLEM STATEMENT

## Introduction

Research has shown that cooperation among adults promotes achievement, social support, and self-esteem. Cooperation is a concept that is found often in the adult work force. Ministers have begun group counseling sessions, asking for volunteers to assist in many areas. Doctors are engaging in group practices, utilizing areas of expertise for consulting purposes. Team management is used in many executive positions. The military often trains men and women in intricate maneuvers which can be taught to others (Brandt, 1987). Since the adult world revolves around teamwork, it makes sense that our children should become involved in this technique through school. Cooperative learning can influence peer pressure, encourage classmates to succeed, and provide an increase in self-esteem.

Cooperative learning practices in schools across North America have not been used extensively for the past 25 years. However, there is a trend once again

for this method of instruction. Students are now working toward a common goal, depending upon the individual learning of each group member. There is now evidence that students working together toward a common goal can accomplish more than those students working independently (Slavin, 1987).

## Statement of the Problem

This study was designed to answer the following question: Is there a significant difference in the spelling achievement of fourth grade students who are taught through cooperative learning groups and those who are taught in the traditional manner?

## Assumptions

For the purposes of this study, the following assumptions were made:

1. The experimental group would be heterogeneously grouped based on reading level.

2. The control group would not be grouped in any structured manner based on ability.

3. The instruments of measurement would be valid and reliable.

4. Both groups would have equivalent instruction in spelling.

5. The students in the experimental group would be assigned to groups of 4-5, depending on class size.

## Delimitations

The following limitations applied to this study:

1. The students were from two intact classrooms.

2. The students came from middle to upper-middle income families.

3. This public school was located in an urban area within a large county system.

4. Fifty-one fourth grade students were involved in the study.

5. Parents were very involved with their children, often giving added assistance at home with weekly spelling words.

## Definitions of Terms

The following terms were used throughout this study:

1. Cooperative learning groups - learning groups of 4-5 students in which the students worked together, or cooperatively, toward a common goal

2. Interdependence - the mutual dependence of the members in a particular group

3. Traditional manner of learning spelling words - individual students completing individual assignments (writing words in alphabetical order, writing own sentences using the list words, locating guide word and page numbers from the glossary, completing pages from the basal speller)

4. Motivation - a combination of the desire to succeed and the incentive to succeed

5. Heterogeneous grouping - assigning high, average, and low performance students to a group

6. STAD - Student Teams-Achievement Division

7. TGT - Teams-Games-Tournaments

8. TAI - Team Assisted Individualization

Section II

## REVIEW OF THE LITERATURE

### Definition

Cooperative learning is an alternative to the traditional instructional method. Cooperative learning refers to the involvement and coordination of efforts between two or more individuals. Students use techniques in heterogeneous groups of two to six. The ultimate goal is to coordinate performances or attainments between fellow cooperators. Communication is essential (Slavin, 1983).

Cooperative learning allows students to celebrate the successes of others. It encourages students to work together regardless of background, race, sex, or mental ability. A cooperative group should have a sense of shared responsibility as well as a sense of individual accountability. One or two students should not do the work of the entire group. Cooperative learning groups need to be structured and managed by one individual, in most cases, the classroom teacher (Johnson & Johnson, 1987).

Cooperative learning allows students to help each other learn, to share ideas and resources, and to plan what needs to be learned. The teacher's role is to model the same social and communication skills that she is trying to convey to the class (in other words, to set the example). The teacher does not dictate specific instructions but allows the students to have some choice in the goals of the activity. Students should be active participants in the process of acquiring knowledge (Sharan & Sharan, 1987).

## Background

Cooperative learning is not a new concept. In order to learn, according to the Talmud, a learning partner is needed. Quintillian pointed out in his Institutio Oratoria in the first century, the benefits of younger children learning from older children in the same class (cited in Slavin, 1983). John Comenius, who published the Didactica Magna in 1632, believed in students teaching and being taught by other students (cited in Johnson & Johnson, 1986).

Perhaps the most widely known advocate in the area of students learning from other students is Joseph Lancaster, an English Quaker. In 1798, Lancaster

opened a school for poor children, and due to a lack of funds, students were utilized as teachers. Improvements in Education (1806), a book written by Lancaster, documents the results of this experiment. Based on his findings, models of this school were popular in the United States for approximately thirty years. A Lancastrian school was opened in the United States in the early 1800's. This school placed emphasis on the elements of cooperative learning (Gartner, Kohler, & Reisman, 1971).

Andrew Bell had developed ideas similar to those of Lancaster's at the same time period. Bell believed that not only was the use of students as teachers economical, but it also provided a positive effect to the students' learning. However, this approach became mechanized and evaluation became unimportant. A public outcry followed as more professional teachers became available (Gartner, Kohler, & Reisman, 1971).

William Bentley Fowle continued to use the Lancaster model even though most systems had abandoned this method. Fowle, a nineteenth century educator, believed in the mutual instructional system with a learner-focused style. He abhorred the traditional school structure, stating that students' teaching was

the preferred technique. He felt that the benefits of this technique were two-fold; the advanced students were able to review their studies and the younger students were able to learn in a style which suited their ages (cited in Gartner, Kohler, & Reisman, 1971).

Colonel Francis Parker was also an advocate of cooperative learning. Colonel Parker, the superintendent of the public schools in Quincy, Massachusetts (1875-1880), brought the sense of cooperation and democracy into the classroom. He believed that enthusiasm and a devotion to freedom and individuality were important components in the public schools. During his tenure as superintendent, approximately 30,000 visitors examined his use of cooperative learning techniques. Colonel Parker's methods dominated American education through the turn of the century (Johnson & Johnson, 1986).

John Dewey followed Colonel Parker by promoting the use of cooperative learning groups. Dewey used this method of instruction as part of his famous project method in instruction (Johnson & Johnson, 1986). However, in the late 1930's, interpersonal competition became the method emphasized in most public schools.

In 1940, Lippitt and White conducted a study involving the grouping of students into three types of groups which were randomly selected. One group was supervised by an authority figure, the second by a democratic group-decision process, and the third group by a laissez-faire method where students were allowed to do as they pleased. At times, the autocratic group expressed hostility and aggression. Discontent was present even though it did not surface at all times. There was less individuality and more dependence on the group leader. Motivation was stronger in the democratic group, thereby producing more efficiency. This group exhibited more friendliness and more group-mindedness. Originality was prevalent. Mutual respect, friendly remarks, and more willingness to share were common qualities exhibited within this group. There was less work completed in the laissez-faire group. More play was evident which accounted for less productivity. The quality of the work was poorer than in the other two groups. Results of this study indicated a strong correlation to the social climate in a classroom as related to student achievement and interpersonal interactions of students (Lippitt, 1940).

Morton Deutsch, in the 1940's, built on the theories of Kurt Lewin. He conducted a study of the differences between cooperative learning and competitive learning. He found no significant differences in learning between students who were graded cooperatively and those graded competitively, although those in the cooperative group worked together more smoothly (Deutsch, 1949). Haines (1959), followed up on Deutsch's work and found no significant differences in achievement between the two groups but did note a marked difference in the group's morale.

Currently, there are several groups of researchers and practitioners throughout the United States and Canada who are engaged in the study of cooperative learning procedures. Robert Slavin and colleagues have developed techniques based on the findings of David DeVries and Keith Edwards from Johns Hopkins University. (See Section II, Cooperative Learning Methods.) A Jigsaw procedure for using curriculum materials based on cooperative learning techniques was developed by Elliot Aronson at the University of California, Santa Cruz. In Israel, Yael Sharan and Shlomo Sharan conduct workshops designed to prepare teachers who wish to foster the elements of cooperative learning within the

classroom. David W. Johnson, Roger T. Johnson, and Edythe Johnson Holubec, authors of Circles of Learning (1986), have been advocates of the cooperative learning practice since the mid 1970's. William Glasser, author of Schools Without Failure and Control Theory has published a book on classroom practices entitled Control Theory in the Classroom which describes how teachers can use cooperative learning techniques to promote more interest and more motivation in learning (Glasser, 1986).

## Cooperative Learning and Peer Relationships

Peer relationships have been a critical element in the development of the child. Interactions with peers tend to be more frequent, intense, and varied through childhood and adolescence (Hartup, 1976). Children and adolescents imitate the behaviors of others and identify with admired competencies. Interaction with peers allows support, opportunities, and models for students. Many forms of values and commitments could not be developed without peers. Children and adolescents learn to view situations from other perspectives through interaction with peers. Autonomy is the ability to understand what others expect in a

given situation and yet feel free to choose whether to meet the expectations. Autonomy allows students to consider the internal values and the requirement to respond in the appropriate manner (Johnson, Johnson, & Holubec, 1986).

According to Johnson (1980), peer acceptance is correlated to the ability to engage in social situations, the extent students provide social rewards for peers, and the ability to utilize academic situations.

Cooperative skills teach that a member would be rewarded for any activity that contributes to the group. A "sink or swim together" approach is an essential element in cooperative classrooms. In a study conducted by Morton Deutsch (1939), members of cooperative groups expressed more friendliness within a group, encouragement for others, and less aggression. In cooperative groups, almost any idea that a member contributes might aid in the solution of the problem.

Cooperative learning methods can be used at any grade level in any subject area. In the past, most methods were curriculum free; they rarely replaced the textbook or teaching approaches. As a result, cooperative learning groups were often used as a

supplement to the core curriculum. Since 1980, however, research conducted at Johns Hopkins University began to focus on methods to replace traditional instruction (Slavin, 1987). (See Section II, Cooperative Learning Methods.)

## Basic Elements

Cooperative learning skills incorporate certain basic elements: positive interdependence, face-to-face interaction, individual accountability, collaborative skills, and processing (Johnson, Johnson, & Holubec, 1986). Positive interdependence involves the group agreeing on one answer and the process involved in solving the problem. This is the key to group productivity. Members need to commit to a mutual purpose. There are several ways to promote this commitment. Positive Goal Interdependence exists when students share a set of goals and all members work together to accomplish this goal. Members may sign the one final product, indicating that each member contributed and concurred with the end result. The evaluator may select one group member to be evaluated either through written work or orally. A progress chart can be developed, recording and averaging the

members' performances. Each member may be assigned to complete a different learning task with the stipulation that each member should complete the task in order for the group to be finished (Johnson, Johnson, & Holubec, 1986).

Positive Reward Interdependence involves giving the same reward to each group member once the task is completed. All are rewarded or none are rewarded. Ways to promote this are assigning a group grade based upon group effort, giving bonus points once the group achieves its goal, distributing nonacademic rewards, and praise given by the evaluator for the group as a whole (Johnson, Johnson, & Holubec, 1986).

When only a portion of information, resources, or materials is necessary for a completed task, Positive Resource Interdependence exists. In order to structure this process, the following methods can be included: limiting resources, allowing each member to have a set of materials, or stipulating that each member must contribute at least one sentence per paragraph (Johnson, Johnson, & Holubec, 1986).

Positive Role Interdependence exists when members are assigned interconnecting roles. Roles are rotated

daily so that each student experiences each role (Johnson, Johnson, & Holubec, 1986).

Positive Task Interdependence allows a factory-line model whereby each member needs to complete the task in order for the next member to complete the overall task (Johnson, Johnson, & Holubec, 1986).

When a group is structured by the physical environment, Environmental Interdependence exists. Chairs or desks can be moved together, an assigned area for each group can be designated, or members can have feet touching within a circle as members work (Johnson, Johnson, & Holubec, 1986).

Face-to-face interaction builds on the skills achieved through positive interdependence. Students help, assist, encourage, and support the efforts of others by explaining to others, discussing ideas learned, teaching one's own knowledge to others, and providing a connection between present and past learning (Johnson, Johnson, & Holubec, 1986).

Individual accountability is promoted by assuring that each member has the correct answer agreed upon and that the correct procedure can be explained. The purpose is to maximize the achievement of each group member. Students need to feel individually accountable

in order to ensure the success of the group. Individual tests may be given to assess an individual's progress. Randomly selecting one member to explain the answer and/or procedure used to solve the problem can also be used for evaluative purposes (Johnson, Johnson, & Holubec, 1986).

Collaborative skills promote leadership, decision-making, trust-building, and communication among group members. These skills allow the group to discuss and criticize ideas, not an individual. These skills need to be taught, not assumed (Johnson, Johnson, & Holubec, 1986). Collaborative skills are ensured by the roles of the encourager and the checker. The encourager asks clarifying questions and encourages all members to participate in the discussion, sharing ideas and feelings. This person invites silent members to participate by asking for an opinion or comments. The checker's responsibility is an evaluative one. This role ensures that the group is in agreement with the final product. If changes have been made after the discussion, the checker is responsible for ensuring that the group members understand why the changes were made and can explain or summarize the material. The checker is also responsible for identifying any errors.

Collaborative skills promote the feeling of jointly working together toward a common goal.

Processing is the summarizing of the group's activities. Students discuss the effectiveness of the group's efforts and the potential to make the group more effective for future purposes. This allows students to focus on group maintenance, builds on the collaborative skills, and allows feedback to members (Johnson & Johnson, 1984, 1987).

## Cooperative Learning Methods

There are several methods of cooperative learning currently being used. The following provides a summary of the most commonly used methods:

Student Team Learning techniques were developed by Robert Slavin, David DeVries, and Keith Edwards at Johns Hopkins University (Slavin, 1980). Three learning methods are now in use: Student Teams-Achievement Division, Teams-Games-Tournament, and Jigsaw II.

Student Teams-Achievement Division (STAD) are groups composed of differing levels. High, average, and low performance students are teamed in groups of four or five. New material is introduced by the teacher in a lecture or discussion. Each team is

responsible for studying worksheets on the material. Teams are allowed to work in pairs, discuss materials in a group, or take turns quizzing each other. The assignment is not completed until the teammates are sure that the material is understood. After practice, quizzes are given on an individual basis. Help among teammates is not permitted. The system of grading is determined by the amount the individual's quiz score exceeds the past quiz average. In this way, every child is given an opportunity to contribute maximum points to the team. It avoids the possibility of low performance students not being fully accepted by the group. A weekly newsletter is written recognizing teams with the highest scores. Individuals are also recognized if past performance is exceeded (Slavin, 1980).

Teams-Games-Tournaments (TGT) (DeVries & Slavin, 1978; DeVries, Slavin, Tennessey, Edwards, & Lombardo, 1980) use academic games to show individual mastery of a subject. Weekly tournaments are held against teams of comparable past performance. Students are told only that the competition will be fair so that labeling of high, average, or low achievement is not an issue. The teams remain together for approximately six weeks.

Maximum points are given if the teams perform to the best of their ability. As with STAD, team scores are featured in the weekly newsletter. A similar pattern of teaching, team worksheet study, individual evaluation, and team recognition are used with TGT. The major difference is the use of games for assessment purposes rather than quizzes (Slavin, 1980).

Team Assisted Individualization (TAI) is the most recent development of the Johns Hopkins Student Team Learning Methods (Slavin, Leavey, & Madden, 1982). Team learning and individual instruction are combined and applied to the instruction of mathematics. A diagnostic test is used to place students in heterogeneous groups of four or five members. Each student works through a set of math units. A sequence of activities are followed, with a test as a final evaluation. An 80% or better is needed in order to pass a checkout. A team score is given based on individual test scores and the number of tests completed in one week. TAI is unique because it not only uses cooperative learning techniques but also includes individualized methods. When a class is too heterogeneous for grouping purposes, TAI can be the answer (Slavin, 1980).

The Jigsaw Method was developed by Elliot Aronson in 1978. It involves assigning students to groups of six. Each section of an academic area is broken down into five parts. Each student is responsible for reading or reporting on his own section. Two students share a section in case of absence. In this way, all five students are guaranteed to be covered. Once the material is completed, different members of teams break into groups to discuss the sections. Students then return to the original group and share the acquired information with their teammates. Students are allowed to quiz one another; individual grades are given. Jigsaw is not a true example of cooperative learning since it does not use a cooperative incentive structure. However, it does use a cooperative task structure which creates interdependence among students (Aronson, 1978).

Robert Slavin developed a modified version of Jigsaw and incorporated in the Student Team Learning program (Slavin, 1980). This method is known as Jigsaw II. Slavin took the elements of TGT, STAD, and Jigsaw and developed a unique technique. Groups of four or five students are responsible for reading a particular topic in a particular assigned area (a chapter, a short story, a unit), and become an expert

on that material. Students with the same topics meet to discuss what was learned and then report back to the respective teams. Team scores are given based on individual quizzes each student is required to take. Improvement scores are also given. Cooperative incentives are a part of this method.

The Learning Together model was developed by David and Roger Johnson in 1975. Four or five students are assigned to heterogeneous groups to work on assignment sheets. One paper is handed in as the final product and receives praise based on how well the group works together as well as the results of the final product. This method of cooperative learning includes competitive and individualistic methods as well as the elements of cooperation (Johnson & Johnson, 1980).

Group Investigation, developed by Yael Sharan and Shlomo Sharan in 1976, involves students working in small groups using inquiry, group discussion, and planning. Students form their own groups with members of two to six students. Students choose subtopics from a unit and break the subtopics into sections, with individual students being responsible for their own section. A group report is required which is presented

to the class. Evaluation is based on the quality of the work (Sharan & Sharan, 1984).

In summary, these six methods are the most researched and most commonly used cooperative learning techniques. All include the basic elements of cooperative learning, learning to work together in order to accomplish a goal within a group, but do differ from one another. STAD, TGT, and TAI are structured and include an incentive reward. Group-Investigation and Learning Together are more autonomous and include less specified group rewards. Jigsaw and Jigsaw II are primarily used in Social Studies classes; TAI is designed for math only. STAD, TGT, and Learning Together are used in all subject areas. Competition between teams is used in STAD, TGT, and Jigsaw II. STAD, TGT, and TAI are designed to help students master skills while Group-Investigation was developed primarily to aid in creative thinking (Slavin, 1980).

## Decisions

When structuring cooperative learning lessons, several decisions need to be made. The instructional objective is the first step toward organizing a lesson. This objective needs to be specific and should match

the level of instruction for a particular group. A collaborative objective also needs to be determined. The specific collaborative skills need to be emphasized when planning the instructional objective (Johnson & Johnson, 1987).

Once the objective is determined, the group size needs to be considered. Cooperative learning groups can range in size from two to six students. Several factors need to be considered concerning group size. As the size of a group increases, the abilities, expertise, and skills increase. This increases the chance of having someone with some special knowledge in that particular area. In a larger group, an opportunity needs to be provided so that all members have a chance to speak and actively participate. The collaborative skills in particular, need to be emphasized in order to ensure appropriate participation of all group members. Materials also need to be specific and adequate to any chosen group size. Time also plays a factor. Smaller groups tend to be more effective with a shorter time frame. Less time is taken with organizational factors when working with a smaller group (Johnson & Johnson, 1987).

Once the size is determined, the assignment of students to groups is the next step to be taken. In general, heterogeneous grouping is the preferred method for most activities (Slavin, 1980). Students from high, average, and low ability grouping allows more giving and receiving of information, a larger perspective when discussing material, and a more accurate long-term retention. Homogeneous grouping may be used to master specific skills (Johnson & Johnson, 1986). Students have been allowed to group themselves, although often, students tend to group themselves homogeneously. (One method to discourage this is to instruct students to list three classmates with whom they would like to work and then assigning at least one listed student.) Randomly assigning students, such as counting off by three's and four's, is another method. Base groups need to stay together long enough to feel success and to form a certain amount of bonding. A semester or a grading period time frame are common methods chosen. Random grouping can be done at the discretion of the teacher. This allows students to identify with the base group but provides an opportunity for students to work with others on a limited basis (Johnson & Johnson & Holubec, 1986).

The room arrangement is another factor to be considered. Students need to be physically close enough to ensure effective communication without disturbing other groups. The instructor also needs to have access in order to freely monitor each group's activities. Once activities begin, students need to be able to see all materials, exchange ideas comfortably, and have eye contact with each member (Johnson, Johnson, & Holubec, 1986).

Each group member needs to have an assigned role to ensure maximum participation. The following is a list of roles that may be assigned:

Reader: This role involves reading the completed activity aloud to the group and/or class.

Writer/Recorder: This student is assigned the task of recording the best answers of the group. Each member needs to sign the completed material and turn it into the teacher.

Encourager: This role is created to ensure that all members participate and have an equal opportunity to contribute ideas and suggestions.

Checker: This role has an evaluative purpose. The checker is responsible for ensuring that each group member can explain or summarize the material.

Praiser: This role discourages negative comments from the group towards any single member. The group should feel good about contributions without the fear of criticism or ridicule.

Time-keeper: This individual is responsible for ensuring that the group is on task. A designated amount of time is announced by the teacher and the time-keeper periodically reminds the group members as to how much time is left.

The above roles are assigned to create positive interdependence. Other roles may be assigned or designed at the discretion of the teacher. It is important that roles are created that fit the task and the students involved (Johnson & Johnson, 1987).

## Implementation

Once a teacher commits to the idea of using cooperative learning techniques in the classroom, several stages need to be established. Teachers need to be aware of using this technique gradually. If this method is used too quickly, failure can follow (Johnson, Johnson, & Holubec, 1986). A single lesson should be used initially, building into one particular

subject area. Using cooperative learning techniques once a week is suggested.

A long-range plan needs to be implemented. Perseverance is important. There may be an initial awkwardness, but once students learn to use collaborative skills, the techniques will become natural. Cooperative learning needs to be introduced at the beginning of the school year so that students are aware and become comfortable with this method of learning (Johnson, Johnson, & Holubec, 1986).

Support from peers is an important factor when using cooperative learning. Sharing successes, problems, new ideas, and curriculum strategies strengthen the effectiveness of this method of teaching and learning. Administrators need to understand the meaning of cooperative learning techniques (Slavin, 1980).

Training is also an important factor. "Hands on" training programs are necessary. Demonstrations and immediate feedback provide a positive method of implementation. Observing another teacher using these techniques can be useful. Joint planning sessions enable teachers to share the burden of developing materials and methods that are needed to conduct

cooperative learning lessons (Johnson, Johnson, & Holubec, 1986).

## Summary

By its simplest definition, cooperative learning is the ability to work together in order to accomplish a goal within a group (Sharan & Sharan, 1987). In the past, cooperative learning had been used in classrooms for many years but was abandoned for a variety of reasons. However, this method has once again become popular in the United States for approximately the past 25 years. Brandt (1987) suggests that the techniques learned in school can have an impact in the adult work force. Therefore, by learning these skills at an early age, students can be better prepared to use a team approach as adults, a method that has become common among adult work forces.

Cooperative learning can also aid in peer relationships. According to Hartup (1976) the interaction with peers is a critical element in the development of the child. Many values are formed through peer relationships. Therefore, structuring lessons which promote an interdependence with others can strengthen the individual and teach students the

necessity of being able to work and cooperate with others in many facets of adult life.

Cooperative learning also develops leadership, decision-making, trust-building, and communication skills. Students are taught to discuss and criticize ideas, not individuals. Through group efforts, members reach a decision on the final product. By establishing interdependence within a base group, members learn to listen and to react to another's judgment. A "sink or swim" attitude is established. By developing collaborative skills, students learn to discuss and contribute differing attitudes and ideas in a positive manner. Individual accountability is monitored closely by the teacher and by the students themselves. Each group member is expected to contribute in order to complete the final product. Through the use of role cards, students are able to experience a variety of responsibilities. Students are taught note-taking and listening skills as well as evaluative and motivational techniques.

There is now evidence that students working together toward a common goal can accomplish more than students working alone (Slavin, 1987). The results of

this study will add to the body of knowledge in this area.

Section III

# METHODOLOGY

## Overview of the Study

This study was designed to determine if the spelling achievement of fourth grade students would be significantly greater if students were taught words through a cooperative learning model. The hypothesis, the description of the sample and the sampling techniques, the experimental design procedures, and the method of data analysis were included in this section.

## Statement of the Hypothesis

This study was designed to test the following hypothesis at the .05 level of significance: There is no significant difference in the spelling achievement of fourth grade students taught through cooperative learning techniques and those taught in the traditional manner.

## Description of the Sample and Sampling Techniques

The subjects involved in this study were from two

intact classrooms. The school was located in an urban area within a large county system. Most of the students came from a two-parent family, with at least one parent holding a college degree. The students were from middle to upper-middle income families. The researcher's class was designated as the experimental group. A total of 25 students were divided into groups based on heterogeneous grouping. When possible, one high, two average, and one low ability student were assigned to a group. These students remained in these designated groups for the entire study.

The control group was a self-contained fourth grade classroom. These students were taught in the traditional manner (see Section I, Definitions). Since it is the philosophy of this school for students to be taught at grade level, no differentiation was made on ability level.

## The Experimental Design

A Stratified Non-randomized Control-Group Pretest-Posttest Design was used for this research. Although one intact classroom was used for the experimental group, there were a total of six cooperative learning groups. The study lasted 12 weeks. During this

12 week period, the experimental group worked with cooperative learning techniques four of the five school days each week. The experimental design is shown in Table 1 below.

Table 1

Non-randomized Two Group Pretest-Posttest Design

| | | Week | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Group- | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| E | $T_1$ | X | X | X | X | X | X | X | X | X | X | X | X | $T_2$ |
| n=25 | | | | | | | | | | | | | | |
| C | $T_1$ | | | | | | | | | | | | | $T_2$ |
| n=26 | | | | | | | | | | | | | | |

E: Experimental Group

C: Control Group

$T_1$: Pretest

$T_2$: Posttest

X: Treatment

## Instrumentation

Before this study began, a teacher-made pretest was given to both the experimental and control groups. After the 12th week of treatment, a posttest was

administered. The posttest was identical to the pretest, the only difference being the time of administration. The pretest and posttest were written in an objective format. Students were required to identify the incorrectly spelled word in a list of four words. There was a total of 20 groups of words. Because the tests were not designed to measure reading ability, both the pretest and posttest were read orally by the researcher (see Appendix B, Lesson Plans).

## The Experimental Procedure

As a way of establishing interdependence within the Experimental Group, groups designed and created banners depicting the name of the group. (These banners were hung above the individual groups.) During the treatment period, both the experimental and control groups received the same assignments and the same instruction. The experimental group was responsible for the management of its own instruction once the teacher-led discussion was completed. This discussion involved the completion of a variety of activities with a set of weekly spelling words. Each day, a different activity was assigned by the teacher (see Appendix B, Lesson Plans). Once the assignment was given, students

were responsible for the management of their own learning. Role cards were distributed (rotated daily), and individual groups would determine their own methods for completing the assignment. Students were responsible for handing in one final copy, with all the signatures of group members, indicating the group approved of the final product. Approximately 25 minutes were given for the group assignment. During this time, the teacher would monitor not only the academic skills but the collaborative skills as well, paying close attention to individual accountability. Once assignments were completed, processing would take place. Each group designed its own method of processing which ranged from a verbal "Thank You," to secret handshakes. The groups would then discuss the successes and failures of the activity. In the beginning, there was a certain amount of awkwardness, but as time went on and interdependence became established, groups were freer in their discussions. Some groups complained about the role of the recorder because much writing is involved. The entire class would discuss problems such as the role of the recorder and try to form some conclusions to a solution.

Another problem was involving all students in a particular activity. Complaints were made concerning the lack of participation by some group members. Whenever this occurred, the teacher would first ask the group to try to work it out among themselves, then present it to the class as a whole and, if both procedures failed, the teacher would intervene. Teacher intervention was required less often as base groups established their own methods of intervention.

During the monitoring stage, the teacher looked for specific behaviors. The appropriate use of roles was observed. If a student was not actively participating, the student would be questioned. Methods of reaching a group decision were monitored. Some groups automatically agreed with chosen answers while other groups used a majority-rules method of decision-making. In certain situations, groups would decide on their own to have each member contribute, in their own hand-writing, one sentence or one response. These decisions were left up to the individual groups. On study day, groups would orally quiz each member on the set list of words. The teacher would randomly select a word for each student and if the entire group knew the particular word, all members would receive a

star. If any member failed to spell a word correctly, no one in the group received the reward. Students were eager to help group members learn the words so that their group would be rewarded.

The main thrust of the teacher's observation was to check the accountability of individuals and to ensure that all members had an opportunity to contribute. The roles of the Encourager and the Praiser were instrumental in ensuring that the groups were working cooperatively toward a common goal. Each Friday, an oral spelling test was given to all students on an individual basis. These scores were not used in any manner for this research.

The control group had a daily spelling lesson of approximately 20 minutes. The lesson plans were identical to the experimental group, the only difference being the use of cooperative learning techniques with the experimental group. Whereby the experimental group was responsible for the methods and management of its learning, the control group was responsible on an individual basis. Both groups used words in sentences, located guide words and page numbers in the glossary, wrote list words in alphabetical order, and completed pages out of the basal speller.

## Method of Analysis

In order to test the null hypothesis, gain scores were collected from the pretest and posttest and were compared with a two-tailed *t*-test at a .05 level of significance.

## Section IV

## RESULTS AND CONCLUSIONS

This section presents the results from a study of the effects of cooperative learning on the spelling achievement of fourth grade students. The statistical results are reported and discussed. Conclusions are drawn by the researcher, general observations are made, and implications for future practices and research are presented.

### Results

The study tested the following hypothesis: There is no significant difference in the spelling achievement of fourth grade students who are taught through cooperative learning groups and those who are taught in the traditional manner. The data was analyzed by a two-tailed *t*-test for the difference between gain scores. A summary for the collected data is found in Table 2. The detailed statistical computations are found in Appendix E.

Table 2

t-Test Results of the Difference Between Mean Gain Scores of Spelling Achievement Tests

| Experimental Group | Control Group |
|---|---|
| $\bar{X}$ = 2.44 | $\bar{X}$ = 1.73 |
| S = 1.00 | S = 1.15 |
| n = 25 | n = 26 |
| $S^2$ = 1.01 | $S^2$ = 1.32 |
| $t$ = 2.37 | |

This table shows the difference between the mean gain scores between the pretest and posttest for the Experimental and Control Groups. The calculated $t$ was significant at the .05 level. Therefore, the null hypothesis was rejected.

## Conclusions

There was a significant difference in the spelling achievement of fourth grade students favoring students who worked together cooperatively.

## Discussion

The purpose of this study was to determine whether

cooperative learning would increase the spelling achievement of fourth grade students. The study compared the gains in spelling achievement after cooperative learning had been used in the Experimental Group. This gain score was computed as a measure of achievement. A 12 week treatment was administered between the pretest and posttest. Students were involved in cooperative learning techniques four out of the five days per week. The control group did not use cooperative learning during this time period.

According to Slavin (1987), students working together toward a common goal can accomplish more than students working independently. Sharan and Sharan (1987) believe that students should be active participants in the process of acquiring knowledge. Glasser (1986) encourages methods to promote more interest and motivation in learning through cooperative learning techniques. Johnson, Johnson, and Holubec (1986) believe the uses of positive interdependence, face-to-face interaction, individual accountability, collaborative skills, and processing focus in on a learner-centered style of acquiring knowledge.

Because cooperative learning can be taught at any grade level in any subject area, this method of

learning is beginning to replace the traditional method of learning in many classrooms. Teachers are now following known cooperative learning models and adapting them to meet the needs in an individual classroom.

Several factors could have affected the outcome of this study. These are:

1. The study was conducted over a 12 week period which allowed enough time for base groups to establish interdependence.

2. Cooperative learning was used during 80% of the time allotted for spelling instruction in a given week.

3. The researcher received 35 hours of training through the Learning Together Model developed by Johnson, Johnson, and Holubec (1986).

4. Cooperative learning was presented the first day of school (August 28, 1989), and was used consistently throughout the study.

## General Observations

Several observations were made during the 12 week treatment period. In the beginning, students were awkward with one another and often requested teacher

intervention. Students also experienced a lack of initiative and often wanted the teacher to clarify assignments in depth. "Tattling" often occurred, with students eager to place the blame on another member for any problems that may have occurred. By the 12th week of treatment, teacher intervention was seldom required because base groups had established interdependence and their own methods for intervention. At this point, groups were self-sufficient and needed little or no explanations from the teacher. Groups were eager to start an activity and worked towards a given goal cooperatively. Through the roles of praiser and encourager, groups were no longer "pointing the finger" at an individual, discovering their own methods to ensure individual accountability within the base group.

After the 12 week treatment period, cooperative learning was not required for spelling assignments. The researcher allowed students to decide how assignments would be completed. Out of the six groups in the classroom, all six chose to work using cooperative learning methods. Students independently distributed role cards, assigning roles to individual group members. Often, students requested this method of learning, even in subjects other than spelling.

Group work was being done in Math, Social Studies, and Science. At this point in the school year, base groups had been changed three times.

## Implications for Future Research

This research study was designed to determine if cooperative learning made a significant difference in the spelling achievement of fourth grade students. The statistical analysis indicates that there was a significant difference in student achievement. Further research could be done in other content areas such as Math, Social Studies, or Science. Cooperative learning could be used daily in a single subject area. A study could be designed to test the significance of all classrooms within a given grade level. Another study could be conducted involving teachers who were trained in cooperative learning techniques and those who were not.

## Implications for Classroom Practice

Since cooperative learning can be incorporated into any grade level or subject area, this technique could be used across the core curriculum. Groups could be instrumental in the mastery of Math facts.

Problem solving could also be presented as group assignments, encouraging students to use role cards in order to ensure individual accountability. Breaking Social Studies chapters into "mini" units would allow groups to read, summarize, and report to the entire class. Using story starters and assigning groups to complete an entire story within a given time would encourage the use of cooperative learning skills. Science experiments and supplemental activities would lend themselves to many cooperative learning models.

In addition to curriculum, cooperative learning also aids in the development of decision-making and trust-building skills, promotes leadership, and develops communication. Cooperative learning encourages students to work together towards a common goal, thus promoting a commitment among group members. Students are allowed to share ideas, resources, and suggestions without fear of criticism. Because peer relationships are critical in the development of the child, cooperative learning allows interaction with peers which encourages support and models for students. Since much of the adult work force is moving towards a cooperative or group approach, teaching cooperative

learning in schools can better prepare students for the future.

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# APPENDIX A

## PRETEST AND POSTTEST

NAME_____ Pretest August 28, 1989

Find the word that is NOT spelled correctly.

| | | | | |
|---|---|---|---|---|
| 1. | sandy | sawcer | sauce | sample |
| 2. | tramp | treat | treasure | trowsers |
| 3. | kash | king | keg | kill |
| 4. | sock | scour | sorce | sour |
| 5. | apoint | apple | appear | appeal |
| 6. | baseball | bullet | banker | barbar |
| 7. | county | country | colum | court |
| 8. | train | trimm | trap | tree |
| 9. | lap | lid | lodge | lege |
| 10. | staje | stack | star | stand |
| 11. | look | lack | loke | lick |
| 12. | appearance | attendence | afternoon | about |
| 13. | jewell | joke | juggle | jam |
| 14. | dream | drug | drain | dragg |
| 15. | trick | tresure | truck | trash |
| 16. | after | answer | assisstance | actor |
| 17. | past | put | poste | paste |
| 18. | comand | camper | course | crop |
| 19. | camera | cations | carpet | campus |
| 20. | glide | gap | guard | gide |

NAME_____ Posttest November 17, 1989

Find the word that is NOT spelled correctly.

| | | | | |
|---|---|---|---|---|
| 1. | sandy | sawcer | sauce | sample |
| 2. | tramp | treat | treasure | trowsers |
| 3. | kash | king | keg | kill |
| 4. | sock | scour | sorce | sour |
| 5. | apoint | apple | appear | appeal |
| 6. | baseball | bullet | banker | barbar |
| 7. | county | country | colum | court |
| 8. | train | trimm | trap | tree |
| 9. | lap | lid | lodge | lege |
| 10. | staje | stack | star | stand |
| 11. | look | lack | loke | lick |
| 12. | appearance | attendence | afternoon | about |
| 13. | jewell | joke | juggle | jam |
| 14. | dream | drug | drain | dragg |
| 15. | trick | tresure | truck | trash |
| 16. | after | answer | assisstance | actor |
| 17. | past | put | poste | paste |
| 18. | command | camper | course | crop |
| 19. | camera | cations | carpet | campus |
| 20. | glide | gap | gaurd | gide |

## Lesson Plans

Subject Area: Spelling

Grade Level: fourth grade

Lesson Summary: Students will study and master a list of spelling words as outlined by Scott, Foresman

Instructional Objective: Students will use a list of words in order to promote mastery and retention for the weekly spelling test.

Materials: Scott, Foresman basal speller, worksheets, paper, pencil

Time Required: 4 days

Decisions:

Group Size: 4-5

Assignment to Group: base groups assigned according to heterogeneous grouping

Roles:

Recorder: writes down final answer after discussion among group members

Reader: reads the completed assignment orally to class

Encourager/Praiser: makes sure that every group member is participating and that there are no negative comments

Time-keeper: keeps group on task and watches clock to make sure the assignment is completed on time

Checker: goes over final copy, checks, and has all members sign in order to show approval of the final product

The Lesson

Instructional Task

Day 1: Using the list words, students are responsible for listing these words in alphabetical order.

Day 2: Using the list words, students are responsible for writing sentences and/or stories for the 20 assigned words.

Day 3: Using the list words, students are responsible for locating the guide words and the page number of the glossary for each assigned word.

Day 4: Within groups, members orally quiz one another on the list of words. After the 20 minute study session, the teacher randomly calls out words to each student. If every member in a group spells the word correctly, each student receives a star.

Positive Interdependence: Students need to take turns giving responses. All members need to agree before a response can be written. Students discuss and check answers after the assignment is completed.

Individual Accountability: Each member needs to be prepared to give an answer or response and be able to explain how the answer was reached.

Expected Behaviors: Group members need to stay in the same place within the lesson. Quiet voices are required. Listening to group members is essential. Group members need to reach an agreement before writing responses.

Monitoring and Processing

Monitoring: The teacher needs to walk freely through the room, looking for any trouble spots. If an individual is not participating, he will be questioned.

Intervention: The teacher will intervene only when necessary. Group members will be encouraged to settle any disputes within the group.

Processing: Students will discuss the failures and successes of the activity. When possible, other group members will be encouraged to offer

suggestions. A summary of that day's lesson will be given. Individual groups will be encouraged to do a formal process that the group has designed; i.e., handshakes, cheers, phrases, etc.

# APPENDIX C

## STAFF DEVELOPMENT PRESENTATION



As part of our school's Local School Plan of Improvement (LSPI), one of the goals was to incorporate cooperative learning techniques in classrooms. The researcher attended a 35 hour training session in June 1989 through the Illinois Renewal Institute, Inc. The Johnson and Johnson Learning Together Model was explained. As a result of the training program, the researcher conducted two Staff Development presentations at Gwin Oaks Elementary School in Lawrenceville, GA on November 3, 1989, and November 10, 1989. Included in this Appendix is an outline of covered topics presented on November 3, 1989. The additional presentation was a "sharing" session among teachers.

PRESENTED AT GWIN OAKS ELEMENTARY: STAFF DEVELOPMENT

Cooperative Learning November 3, 1989

I. Why Use Cooperative Learning?

II. Definition

III. Background and Methods
- A. Joseph Lancaster
- B. Colonel Francis Parker
- C. John Dewey
- D. Robert Slavin, David DeVries, Keith Edwards
  Student Team Learning
  1. Student Teams-Achievement Division (STAD)
  2. Teams-Games-Tournaments (TGT)
  3. Team Assisted Individualization (TAI)
- E. Elliot Aronson
  Jigsaw Method
- F. Yael Sharan & Shlomo Sharan
- G. David Johnson, Roger Johnson, Edythe Johnson Holubec
  Learning Together Model

IV. Basic Elements
- A. Positive interdependence
- B. Face-to-face interaction
- C. Individual accountability
- D. Collaborative skills
- E. Processing

V. Decisions
- A. Instructional and collaborative objectives
- B. Group size
- C. Group assignment
- D. Room arrangement
- E. Roles
  1. reader
  2. encourager
  3. recorder/writer
  4. praiser
  5. time-keeper
  6. checker

VI. Resources

We learn.....

10% of what we read

20% of what we hear

30% of what we see

50% of what we both see and hear

70% of what is discussed with others

80% of what we experience personally

95% of what we TEACH to someone else

William Glasser

# COOPERATIVE SKILLS



**COMMUNICATION:**
Accurate and Effective Sending and Receiving of Messages

**LEADERSHIP:**
Actions that Help the Group Achieve its Goals and Maintain Good Cooperative Relationships

**TRUST-BUILDING:**
Trusting -- Openness and Sharing
Trustworthy -- Acceptance, Support, Cooperativeness

**CONTROVERSY:**
Conflict Over Ideas, Opinions, Theories, or Procedures

# Cooperative Task Explanation

Task

Cooperative

Positive Interdependence

Individual Accountability

Expected Behaviors

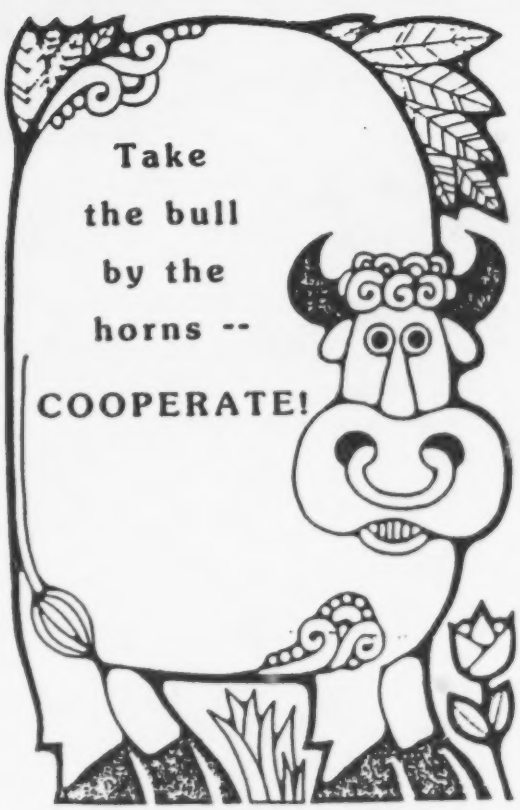
Criteria for Success

# Cooperative Lesson Log

Name _____ School _____

Grade Level _____

| DAY and DATE | DESCRIPTION OF TASKS and ACTIVITIES PERFORMED | SUCCESSES EXPERIENCED | PROBLEMS ENCOUNTERED | SHARED LESSON WITH |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |


Take
the bull
by the
horns --
COOPERATE!

Don't be a pig!
Share
yourself
with others.

EWE
ARE SPECIAL --
Be a
cooperator!

CONGRATULATIONS
to a
FANTASTIC
GROUP!

# THE PEOPLE SEARCH

Focuses on content

Reinforces learning through articulation

Invites meaningful interaction

Exemplifies a model of "safe-risk" climate

Notes value placed on people as resources

Diagnoses prior knowledge or new learning

Signals priorities of unit or semester

READER

"Is everyone listening?"

"Is everything clear?"

"Shall I read any part again?"

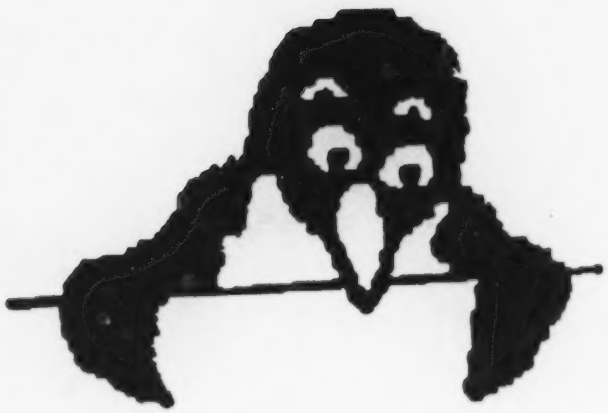
TRAVELLER

"Where do you need help?"

"Did your group understand . . ."

"My group thinks . . ."

"Can you explain . . ."

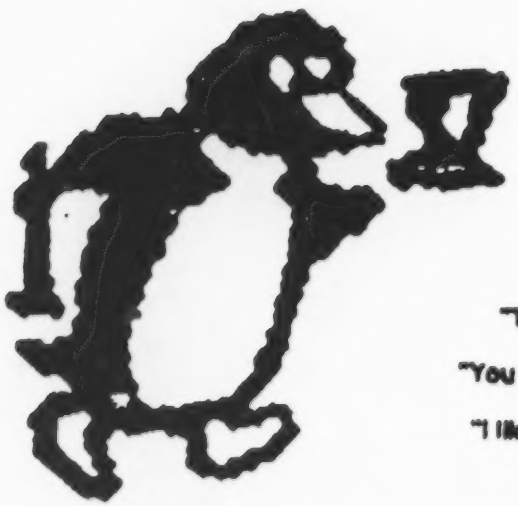


"I heard . . ."

"I noticed . . ."

"I saw . . ."

OBSERVER



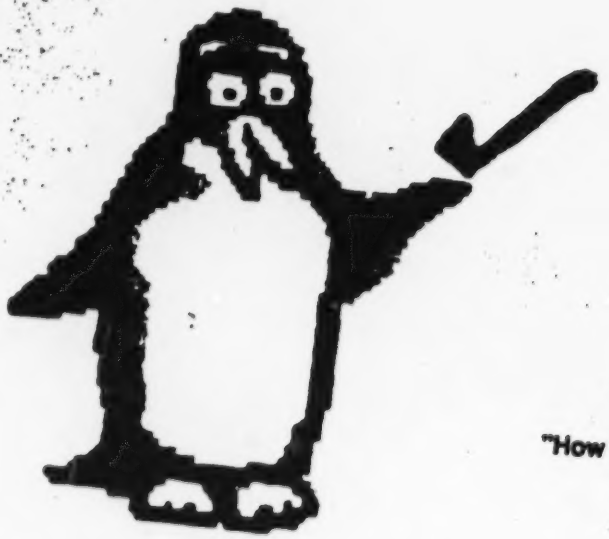
"Good idea."

"Thank you for . . ."

"You helped me when . . ."

"I liked the way you . . ."

PRAISER



CHECKER

"Let's review."

"Explain."

"Give an example."

"How did we get that answer?"

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ILLINOIS RENEWAL INSTITUTE. INC.

# CERTIFICATE OF COMPLETION

AWARDED TO

Patty Kambiss

FOR

## Cooperative Learning - Advanced

DATE

June 22, 1989

James A. Bellanca

EXECUTIVE DIRECTOR

83

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# APPENDIX D

# STUDENT RESPONSES TO COOPERATIVE LEARNING

## Student Reactions to Cooperative Learning

Students were asked to write one sentence summarizing their feelings about cooperative learning. They are as follows:

A.B. . . . Because it is fun and we learn better.

S.F. . . . It saves time, we learn to get along together, and we always have different jobs.

A.Y. . . . It is fun.

L.H. . . . I get to help people.

B.B. . . . Being able to help each other.

B.G. . . . It is much better because everyone is different.

L.S. . . . I like working together.

H.M. . . . I like helping and learning from others.

H.C. . . . You can tell your ideas to others.

J.G. . . . It's cool!

D.H. . . . You can get to know other people better.

M.H. . . . I like working with other people.

B.W. . . . It is so much fun to me.

D.S. . . . Working in groups is great.

J.P. . . . I like checking our work over together.

K.E. . . . We work together nicely.

M.T. . . . I like working together.

J.G. . . . We get to learn in a better way.

E.F. . . . I like working with others.

T.J. . . . We get to work together and learn how to like each other.

J.H. . . . I like working together.

D.G. . . . We all get to share ideas.

K.L. . . . I like working with my classmates.

K.D. . . . I learn more in groups.

K.R. . . . Sharing ideas is a fun way to learn.

APPENDIX E

STATISTICS



Experimental

| Student # | Pretest | Posttest | Gain |
|---|---|---|---|
| 1 | 14 | 17 | 3 |
| 2 | 13 | 15 | 2 |
| 3 | 10 | 12 | 2 |
| 4 | 11 | 14 | 3 |
| 5 | 11 | 15 | 4 |
| 6 | 15 | 16 | 1 |
| 7 | 13 | 15 | 2 |
| 8 | 13 | 16 | 3 |
| 9 | 10 | 12 | 2 |
| 10 | 11 | 13 | 2 |
| 11 | 13 | 14 | 1 |
| 12 | 13 | 16 | 3 |
| 13 | 12 | 15 | 3 |
| 14 | 14 | 18 | 4 |
| 15 | 15 | 17 | 2 |
| 16 | 14 | 17 | 3 |
| 17 | 10 | 14 | 4 |
| 18 | 17 | 19 | 2 |
| 19 | 12 | 13 | 1 |
| 20 | 14 | 16 | 2 |
| 21 | 14 | 17 | 3 |
| 22 | 11 | 12 | 1 |
| 23 | 14 | 15 | 1 |
| 24 | 13 | 16 | 3 |
| 25 | 11 | 15 | 4 |
| 26 | - | - | - |

$\bar{X} = 2.44$

$S = 1.00$

$S^2 = 1.01$

Control

| Student # | Pretest | Posttest | Gain |
|---|---|---|---|
| 1 | 12 | 13 | 1 |
| 2 | 13 | 13 | 0 |
| 3 | 13 | 14 | 1 |
| 4 | 13 | 14 | 1 |
| 5 | 14 | 14 | 0 |
| 6 | 14 | 15 | 1 |
| 7 | 12 | 14 | 2 |
| 8 | 13 | 17 | 4 |
| 9 | 13 | 14 | 1 |
| 10 | 14 | 15 | 1 |
| 11 | 8 | 12 | 4 |
| 12 | 14 | 17 | 3 |
| 13 | 15 | 16 | 1 |
| 14 | 9 | 12 | 3 |
| 15 | 12 | 13 | 1 |
| 16 | 14 | 16 | 2 |
| 17 | 15 | 16 | 1 |
| 18 | 13 | 16 | 3 |
| 19 | 17 | 18 | 1 |
| 20 | 13 | 16 | 3 |
| 21 | 14 | 17 | 3 |
| 22 | 12 | 13 | 1 |
| 23 | 15 | 16 | 1 |
| 24 | 16 | 19 | 3 |
| 25 | 13 | 15 | 2 |
| 26 | 15 | 16 | 1 |

$\overline{X}$ = 1.73

S = 1.15

$S^2$ = 1.32

$\bar{X}_1 = 2.44$ $\bar{X}_2 = 1,73$

$S_1 = 1.00$ $S_2 = 1.15$

$n_1 = 25$ $n_2 = 26$

$S_1^2 = 1.01$ $S_2^2 = 1.32$

$$t = \frac{2.44 - 1.73}{\sqrt{\frac{(24x1.01) + (25x1.32)}{49}(.08)}}$$

$$t = \frac{.71}{\sqrt{\frac{24.24 + 33}{49}(.08)}}$$

$$t = \frac{.71}{\sqrt{\frac{57.24}{49}(.08)}}$$

$$t = \frac{.71}{\sqrt{1.17 \times .08}}$$

$$t = \frac{.71}{\sqrt{.09}}$$

$$t = \frac{.71}{.3}$$

$$t = 2.37$$